2ND OCTOBER, 1964

OPENING OF CONCRETE ROAD BRIDGE

1,000 FT. ARCH SPAN OVER PARRAMATTA RIVER

DEPARTMENT OF MAIN ROADS, NEW SOUTH WALES
AUSTRALIA

HER ROYAL HIGHNESS

Princess Marina,

DUCHESS OF KENT

New Bridge over the Parramatta River
between Gladesville and Drummoyne,
Sydney

Friday, 2nd October, 1964,
at 11.00 a.m.

Opening Ceremony

By

Her Royal Highness Princess Marina,
Duchess of Kent

ORDER OF PROCEEDINGS

The Honourable P. D. Hills, M.L.A.,
Deputy Premier,
Minister for Local Government and
Minister for Highways

will open proceedings

The Honourable J. B. Renshaw, M.L.A.,
Premier, Treasurer and
Minister for Industrial Development
and Decentralisation

will speak

Her Royal Highness Princess Marina,
Duchess of Kent,

will reply

The Bridge will be officially
opened and a plaque unveiled
by
Her Royal Highness
Princess Marina,
Duchess of Kent

" *Advance Australia Fair* "

THE OLD BRIDGE

The old iron opening-span bridge over the Parramatta River connecting Drummoyne and Gladesville and the original bridge over Iron Cove, or Long Cove as it was then called, were both built mainly to shorten the distance to the City from farms and market gardens.

Construction of both bridges was commenced in April, 1878 but twelve months later work on Iron Cove Bridge was suspended to allow efforts to be concentrated on Gladesville Bridge, which was opened to traffic in 1881.

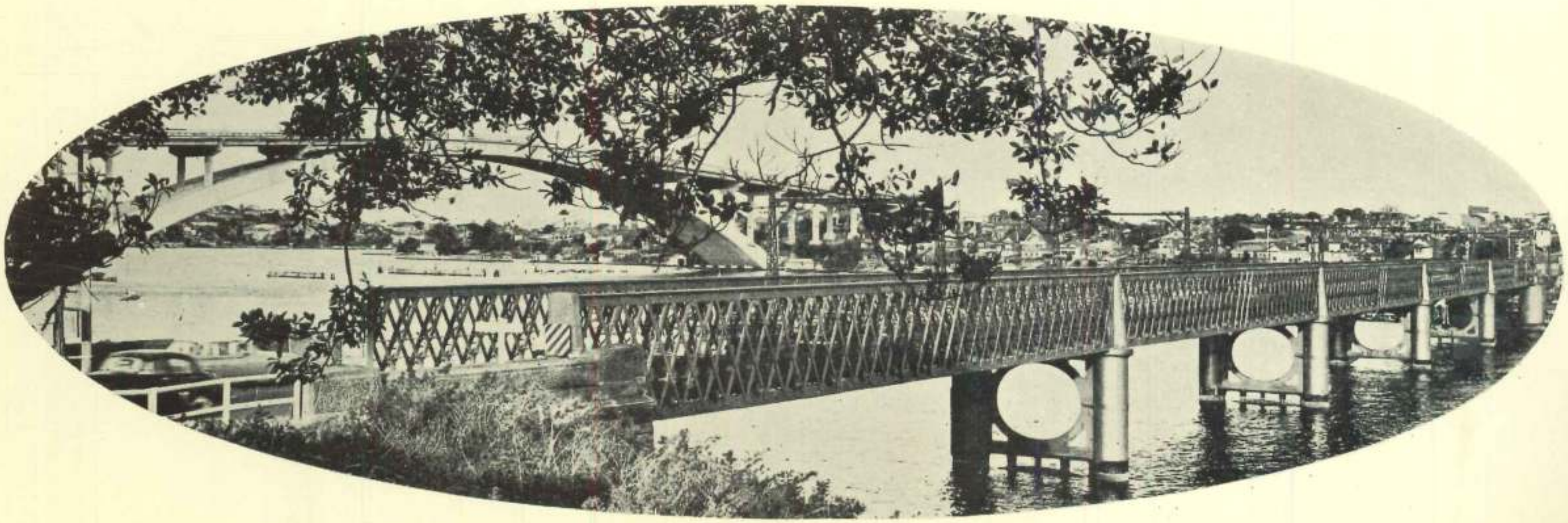
With the opening to traffic of Iron Cove Bridge in November, 1882 and the building of a road to link this and the Gladesville Bridge with existing bridges closer to the City at Glebe Island and Pyrmont, the time of the journey from farm to market was shortened considerably.

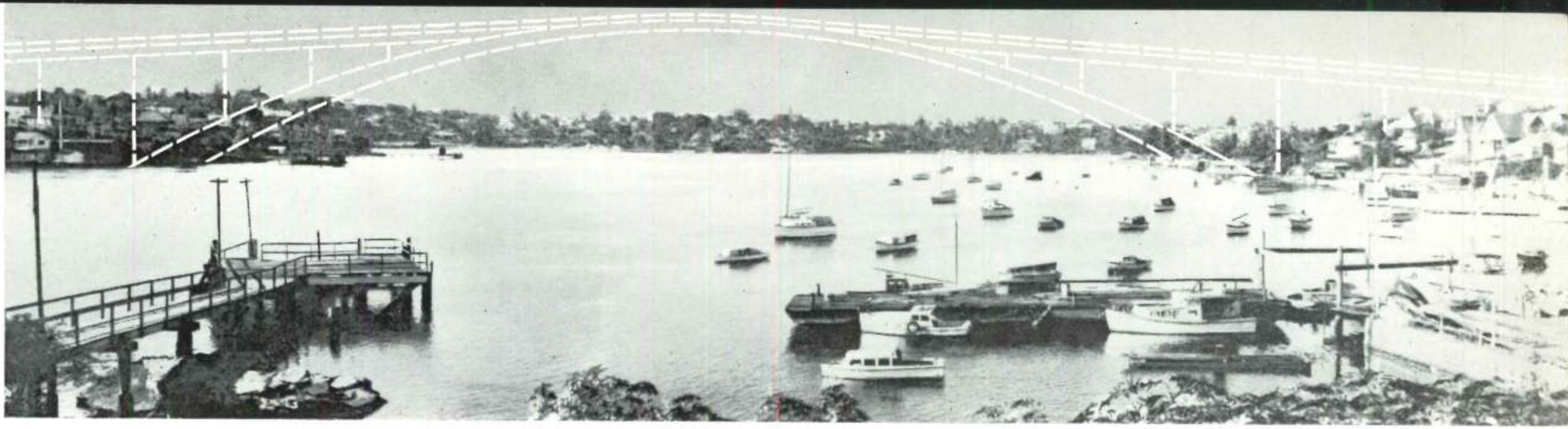
Prior to construction of the old Gladesville Bridge, access across the Parramatta River in the locality was by ferry.

Until Sydney Harbour Bridge was opened to traffic in March, 1932, the old Gladesville Bridge provided the only roadway across the waters of Port Jackson and the Parramatta River between the entrance to the Port and crossings of the river at Parramatta.

The old Gladesville Bridge, which consists of a series of lattice truss spans and is 896 feet long, is to be demolished.

The old bridge over the Parramatta River between Gladesville and Drummoyne





Looking downstream before construction of the new bridge commenced

GENERAL

The new bridge over the Parramatta River between Gladesville and Drummoyne not only replaces a two-lane opening-span bridge which is inadequate for traffic and is approaching the end of its useful life, but also forms part of the future North-Western Expressway which will serve a large section of the northern area of the Sydney Metropolis.

The recently completed Fig Tree Bridge over nearby Lane Cove River and a bridge being constructed over Tarban Creek between the new bridge and Fig Tree Bridge will also be incorporated in the expressway. The aerial photograph on the outside back cover of this brochure illustrates how this length of the expressway will appear when completed.

These three bridges and the road works associated with them will greatly increase Sydney's cross-harbour facilities by providing a favourable route for part of the traffic which would otherwise use Sydney Harbour Bridge about three and a half miles to the east.

Following the invitation of tenders both overseas and in Australia, a contract for the construction of the new bridge was awarded by the Department of Main Roads to the partnership of Stuart Brothers, builders, of Sydney and Reed and Mallik, engineering contractors, of Salisbury, England.

The contractors were also responsible for the preparation of the design of the bridge which was undertaken for them by consulting engineers, Messrs. G. Maunsell and Partners of London and Melbourne.

After acceptance by the Department of Main Roads of the tender for the bridge, an amended design, differing somewhat from that originally proposed, was submitted by the contractors.

The new design provided for the arch to be built on fixed falsework whereas in the original design part of the arch was to have been built on floating falsework towed into position.

The original design provided for an arch span of 910 feet. The amended design increased the span to 1,000 feet and eliminated the necessity for deep-water excavation for arch foundations on the Gladesville (or northern) side of the river.

THE NEW BRIDGE

The design was checked both by the Department of Main Roads and Professor J. W. Roderick and associates of the staff of the Civil Engineering Department of the University of Sydney.

Subsequently, the advice of the late Monsieur E. Freyssinet of Société Technique pour l'Utilisation de la Précontrainte of Paris, was obtained on certain aspects of the design.

Professor J. W. Roderick of the University of Sydney assisted the Department as a general consultant during the construction of the bridge.

The Société Technique pour l'Utilisation de la Précontrainte of Paris acted as consultants in connection with the jacking of the arch ribs. Monsieur Y. Guyon or Monsieur P. Jensen of that organisation was present and assisted with advice as each of the four arch ribs was jacked into position.

Associate Professor D. Campbell-Allen of the University of Sydney acted as a special consultant on concrete.

Associate Professor R. L. Aston of the University of Sydney acted as a special consultant to the Department on the required precision surveying during the arch construction.

The design of the special inner and outer protective barriers along each footway was prepared in accordance with advice and sketches provided by Mr. D. C. Maclurcan of the Sydney firm of architects, Fowell, Mansfield and Maclurcan. Mr. Maclurcan also provided the outline design of the foot-bridge across the Victoria Road connection to the bridge.

The consultants, contractors and major sub-contractors who were engaged on the design and construction of the bridge are listed on the inside back cover of this brochure.

DESCRIPTION

The new bridge is 1,901 feet 6 inches long between abutments. It includes a four-ribbed concrete arch with a span of 1,000 feet and, on each side of the arch, four pre-stressed concrete girder spans each 100 feet long.

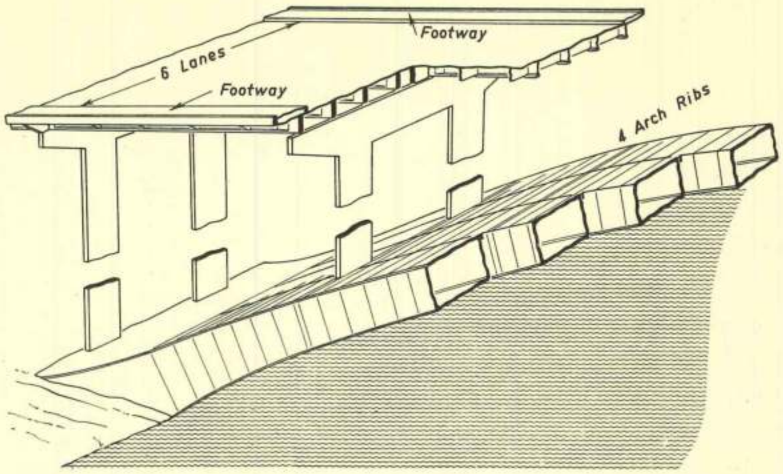
The arch with its clear span of 1,000 feet is the longest concrete arch span yet constructed in the world.

The arch is supported by massive concrete blocks, known as "thrust blocks", founded on sandstone on each side of the river.

The roadway is 72 feet wide between kerbs and is flanked by a footway, 6 feet wide, on each side of the bridge. At the Gladesville (or northern) end of the bridge, the roadway widens gradually over the approach spans from 72 feet to 120 feet to provide for the smooth routing of traffic.

The roadway rises on a grade of 6 feet in each 100 feet from each side of the river and the grades are connected by a vertical curve 300 feet long over the centre of the structure.

The arch has a clearance of not less than 120 feet above water level for a width of 200 feet in the centre of the stream, the maximum clearance at the crown of the arch being 134 feet above water level.



The four separate arch ribs, the columns and the deck of the bridge shown diagrammatically

Construction of the bridge involved the following main operations—

★ Excavation for foundations of—

Arch thrust blocks of concrete on each side of the river at the shore-line and partly below water.

Abutments at the ends of the bridge.

Shore pier columns of the approach spans on each side of the river.

★ Concreting of the arch thrust blocks, the abutments and columns.

CONSTRUCTION

★ Driving of falsework piles in the river and erection of steel falsework to support the hollow concrete blocks and diaphragms forming each of the four arch ribs.

★ Casting of the hollow concrete box units and diaphragms and the erection of the four arch ribs one at a time.

★ Jacking each rib to raise and lift it off the falsework.

★ Casting of concrete deck beams on each side of the river.

★ Erection of the deck beams to form the roadway over the arch.

★ Paving of the concrete roadway and final completion of the structure.

FOUNDATIONS

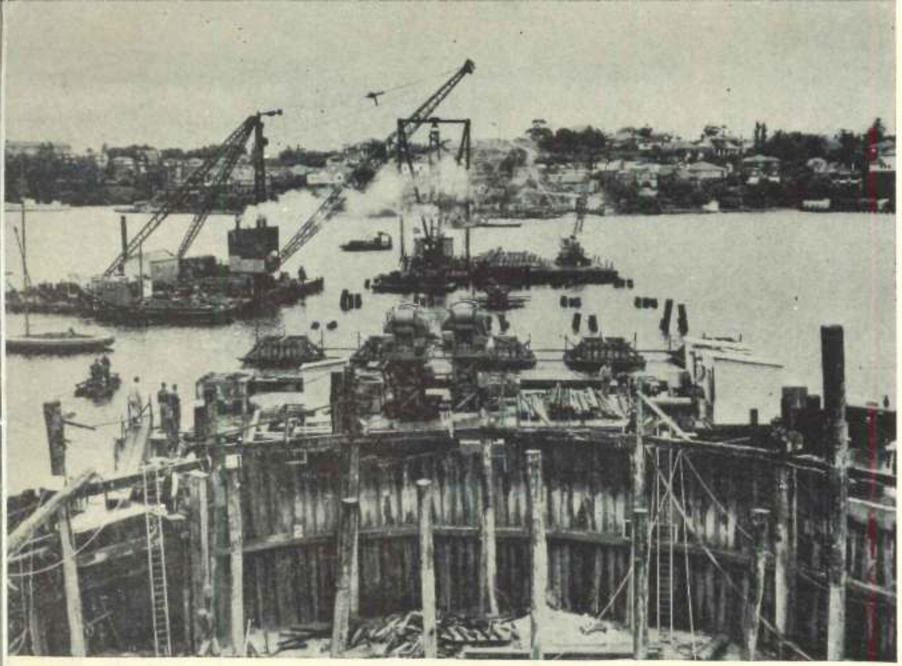
Preliminary work on the foundations for the thrust blocks of the arch began in December, 1959 with the construction of coffer-dams on both banks of the river.

Approximately 2,100 cubic yards of earth and 6,400 cubic yards of sandstone were excavated for the two thrust blocks and for the foundations of the abutments and approach piers of the bridge.

ARCH THRUST BLOCKS

The thrust blocks at each end of the arch are of mass concrete and bear on steps cut in the solid sandstone of the river banks.

The maximum bearing pressure on the sandstone will not exceed 15 tons per square foot.



Tests to destruction of rock samples from the site showed that failure did not take place under a load eight times as great as this.

This high factor of safety is necessary to insure against any foundation failure, which would be calamitous in a structure of this type, and takes into account variations in the quality of the sandstone across the foundation areas.

Concrete in the thrust blocks was placed in layers with an average thickness of about five feet and compacted by vibrators.

The bulk of the concrete in the thrust blocks was of such strength that a force of over 100 tons would be required to crush a cylinder 6 inches in diameter by 12 inches high (over 6,000 lb. per square inch). Where the thrust blocks widened out so that the area available to take the thrust was greatly increased, concrete of lesser strength was used, but it had a strength of at least 2,500 lb. per square inch.

Approximately 14,500 cubic yards of concrete were used in the construction of the thrust blocks.

The construction of the thrust block on the Gladesville side was completed on the 22nd August, 1961 and on the Drummoyne side on the 30th October, 1961.

ABUTMENTS

The abutments at the two ends of the bridge are of reinforced concrete and of box-type with earth filling. They are founded directly on sandstone.

Top *Coffer dam under construction on the Drummoyne side of the river*

Bottom *Excavation for arch thrust block on the Gladesville side*

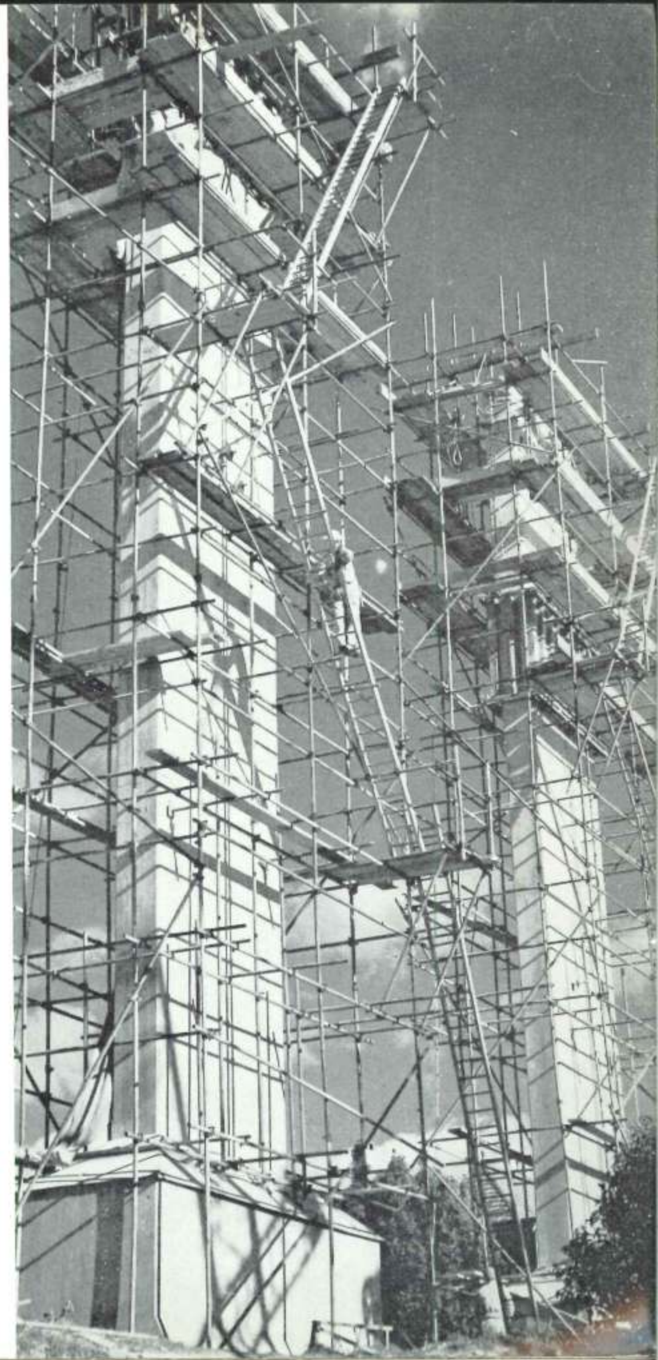
Completed arch thrust blocks on the northern river bank and steel falsework being erected

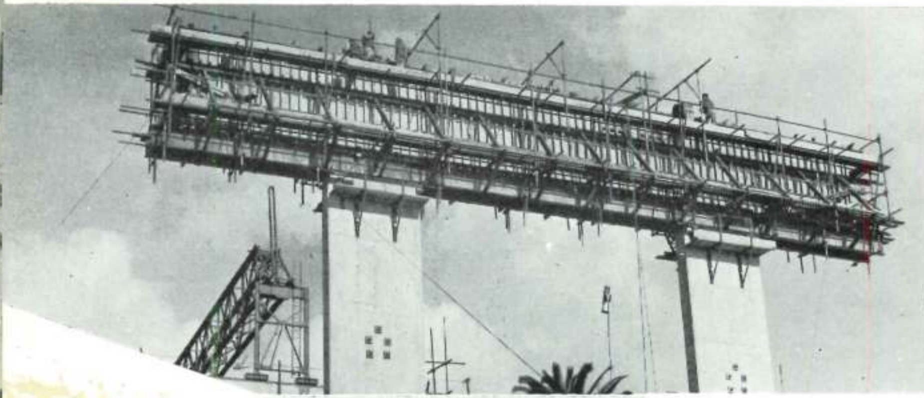
COLUMNS

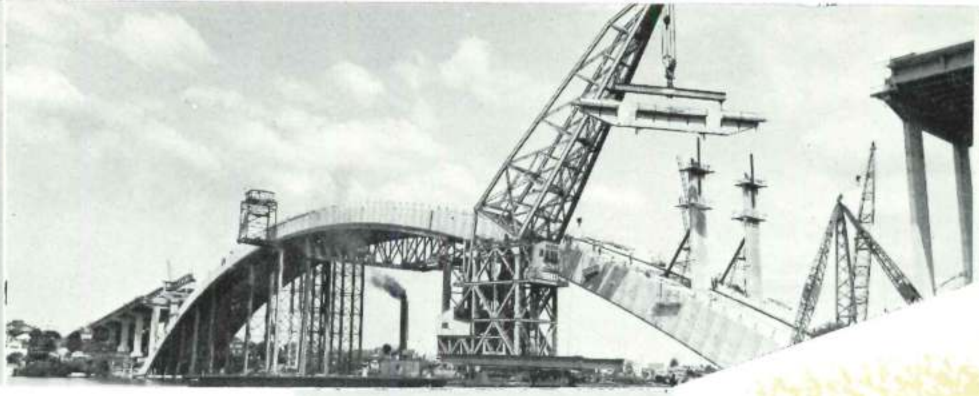
The deck is carried on pairs of prestressed concrete thin-walled columns. The wall thickness is two feet except in the tall columns at the ends of the arch where the wall thickness was increased by six inches.

On top of each pair of columns there is a reinforced concrete headstock.

Pier columns to support an approach span nearing completion





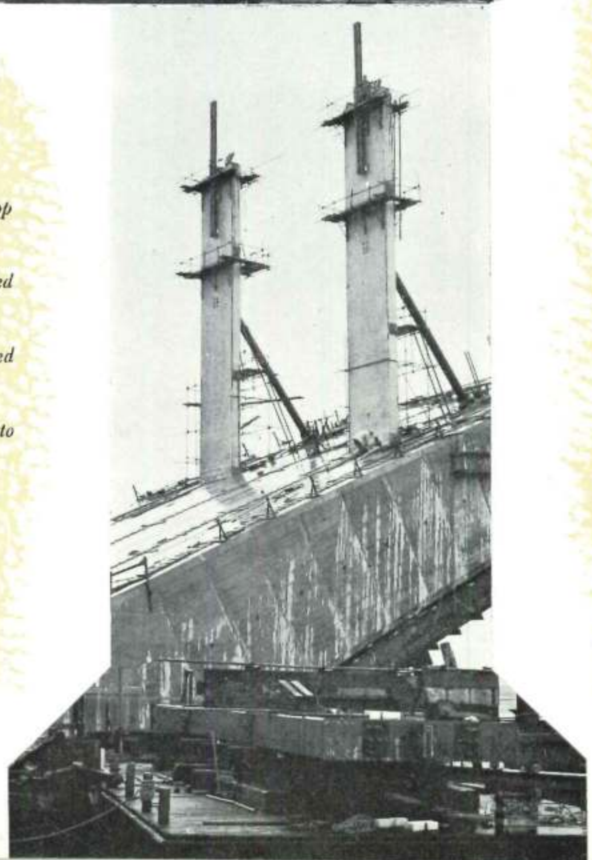


Top left *Construction of headstock on top of pier columns*

Top right *Precast headstock being lowered into position*

Bottom left *Precast column being placed on arch rib*

Bottom right *Columns in position to receive headstock*



FALSEWORK FOR ARCH RIBS

To support the hollow concrete box units and diaphragms which make up each of the four ribs in the arch, it was necessary to provide falsework during construction.

The falsework consisted of steel tubular columns on steel tubular pile trestles carrying spans of steel beams 60 feet long and a steel truss span 220 feet long over an opening left for navigation in the Gladesville (or northern) half of the falsework. These units were tied together and anchored at each end to the thrust blocks. The piles were taken down to rock in the river bed.

At the centre of the falsework, the steel columns formed a braced tower extending the full width of the bridge. The pile trestles had cross members just above water also extending the full width of the bridge.

The rest of the falsework was wide enough to support one rib at a time only. After completion of the first rib, the falsework was moved sideways on rails on the members of the pile trestles to support, in turn, each of the other three ribs.

Machinery installed on the central tower lifted the concrete box units and diaphragms from water level and moved them into position.

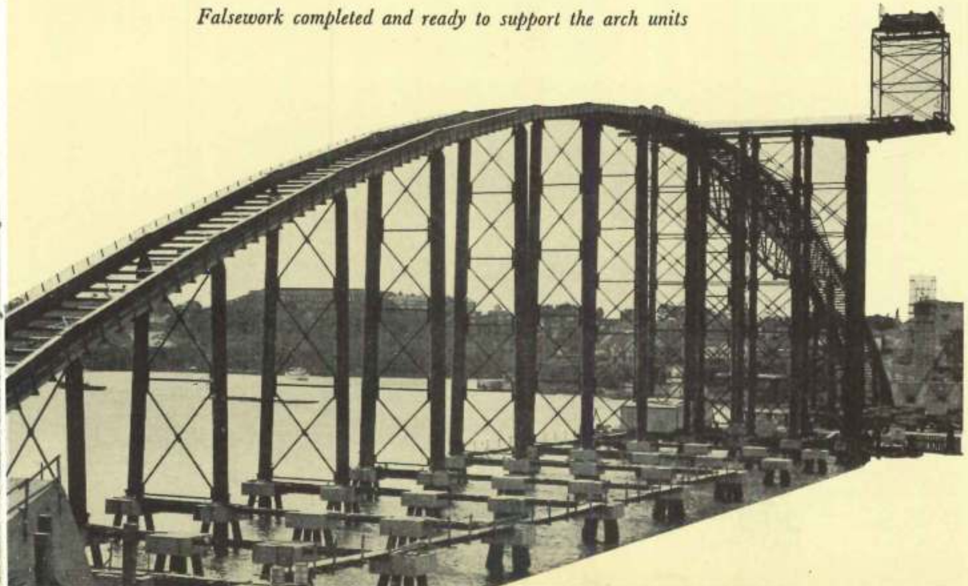
The tower also served as a stay to prevent movement sideways of the individual arch ribs after they became self-supporting and until they were tied together.

A large floating crane was used to lift the long steel tubular columns and trusses into position.

The erection of the falsework was completed in November, 1961.

Falsework, on which the arch ribs were erected, being placed in position

Falsework completed and ready to support the arch units



THE RIBS OF THE ARCH

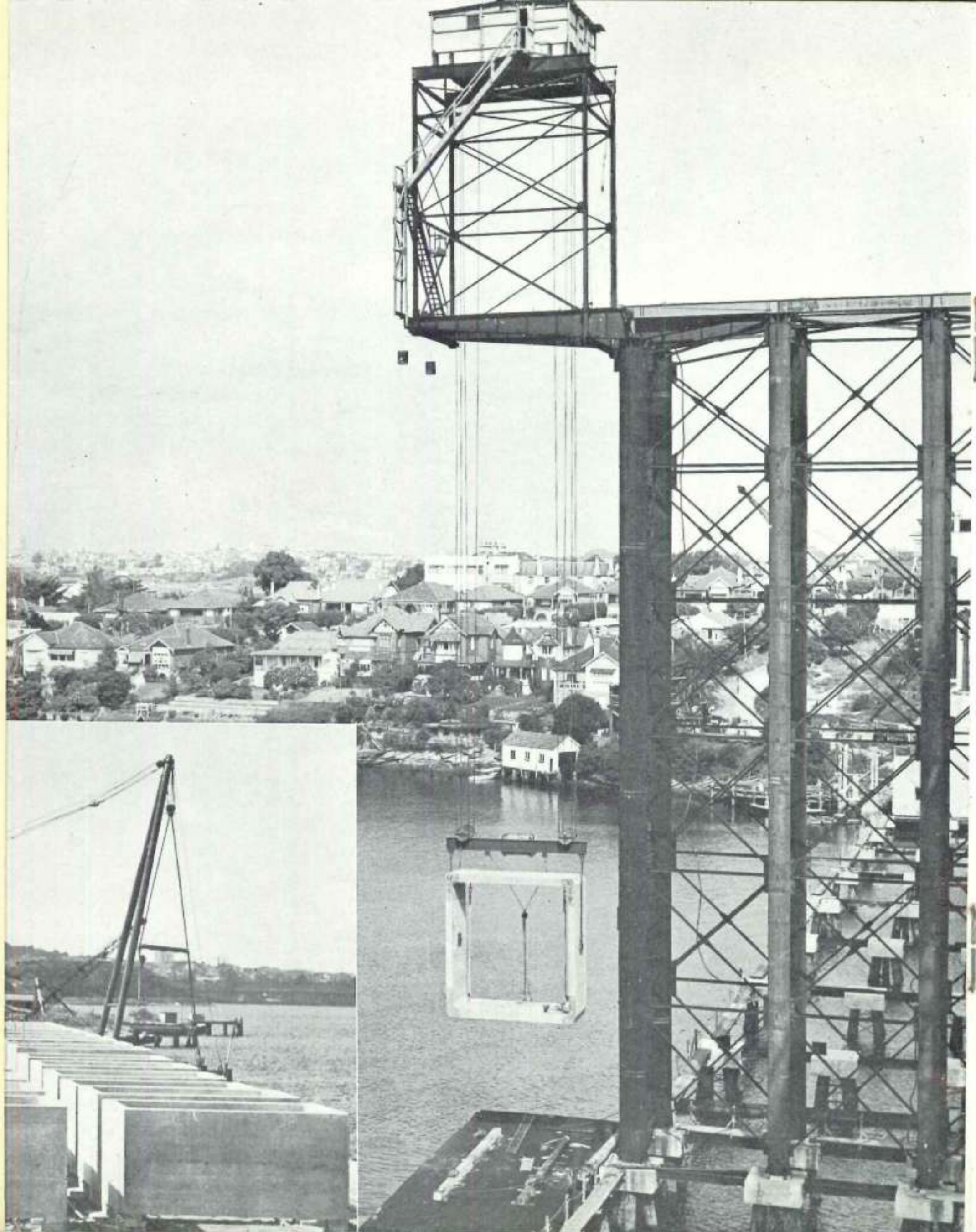
The hollow box units and diaphragms which comprise each rib of the arch were manufactured at Woolwich, three miles downstream from the bridge site, where a casting yard was set up on the water front.

The casting yard was laid out to accommodate at one time all the units for one rib of the arch, i.e., 108 box units and 19 diaphragms.

Each box unit weighs 50 tons and is 20 feet wide with depths decreasing from 23 feet at the thrust block to 14 feet at the crown of the arch, measured at right angles to the axis of the arch. The length of the box units along the arch varies from 7 feet 9 inches to 9 feet 3 inches.

The diaphragms are solid components, except for an opening to allow subsequent access through the rib and are generally 2 feet thick measured along the arch.

After the units were manufactured, they were loaded on lighters and towed to the bridge site.

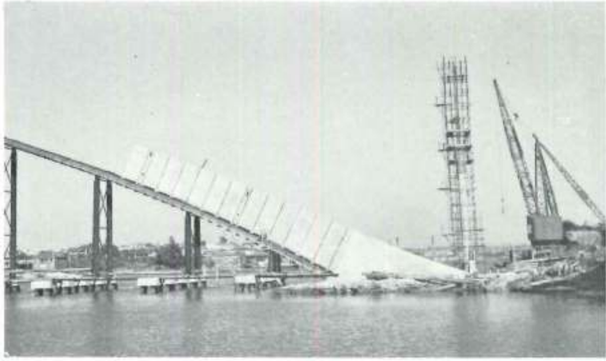


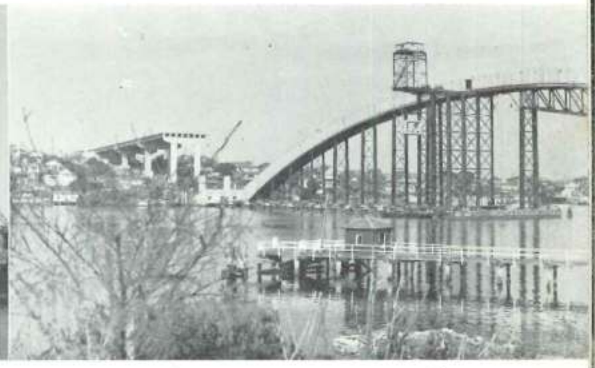
A concrete box unit being hoisted to the top of the falsework

Inset *Precast units ready for transport to the bridge site*

1

2





3

The hollow concrete box units and diaphragms were lifted from lighters to the crown of the falsework and winched down on bogies to their correct positions on the falsework (**1**) and (**2**). The first box unit was placed on the Drummoyne side on the 23rd February, 1962 and on the Gladesville side on the 14th March, 1962. The last box unit in the first rib of the arch was placed in position on the 31st July, 1962 (**3**).

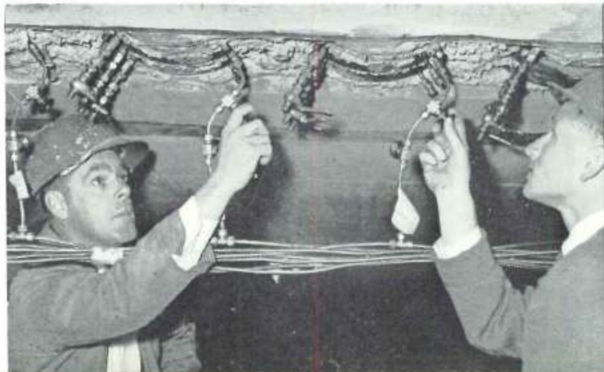
The diaphragms are spaced at intervals of 50 feet to serve the dual purpose of tying the four ribs together transversely and of supporting the slender columns which carry the roadway over the arch.

When the units had been moved into position on the falsework, the gap of three inches between them was filled with concrete. At two points in each rib, four layers of Freyssi flat jacks were inserted. There are 56 jacks in each layer. The rib was then compressed longitudinally by inflating the jacks with oil one layer at a time, (**4**) the oil being replaced with grout and allowed to set before inflation of the next layer of jacks was carried out. The inflation of the jacks increased the distance between the units adjacent to the jacks and hence the overall length of the arch along its centre line. This caused it to rise and lift off the falsework making it self-supporting. The falsework was then moved sideways to carry the components of the next rib.

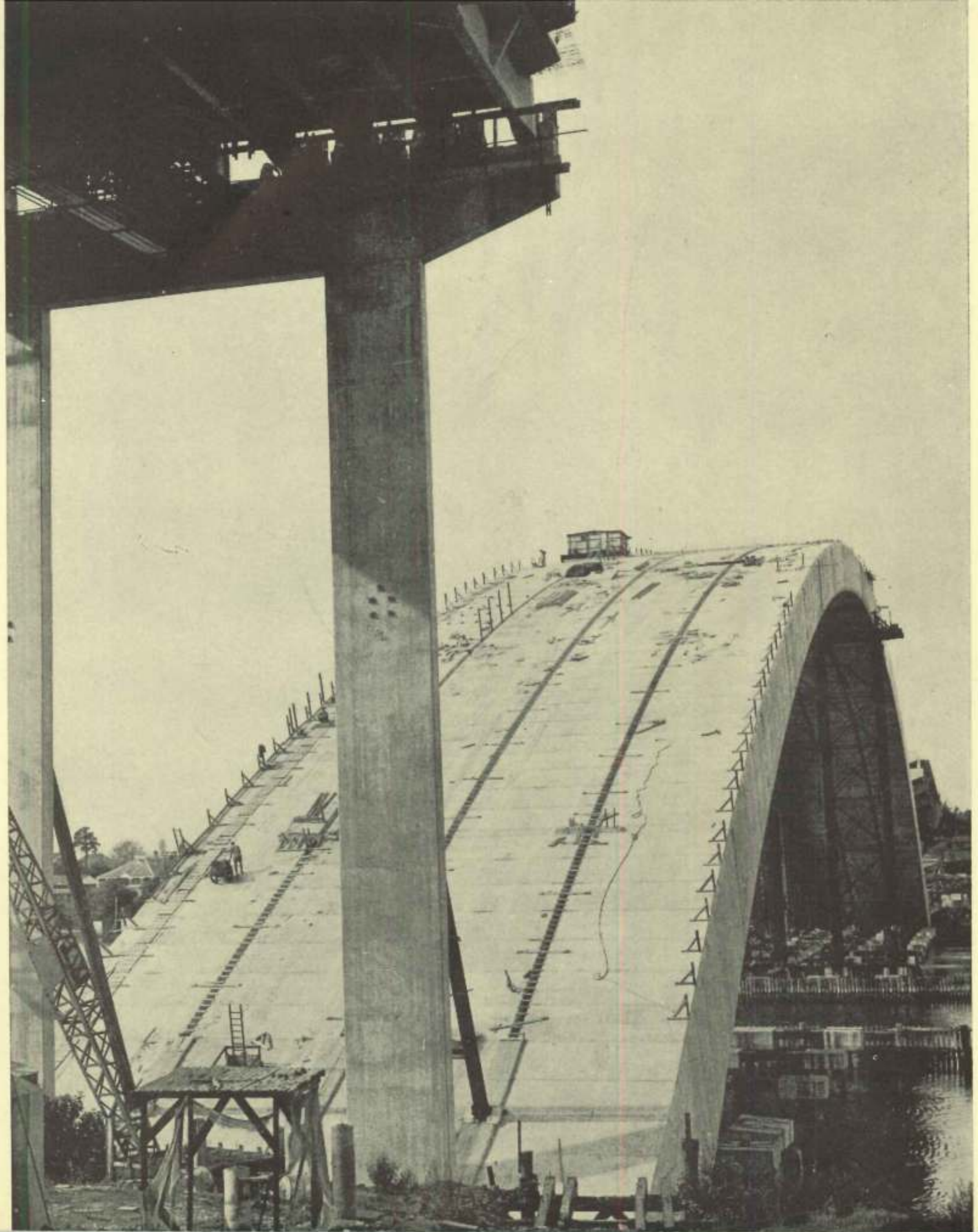
The last box unit was placed in the arch on the 31st May, 1963.

The first rib of the arch became self-supporting in September, 1962, (**5**) the second in January, 1963, the third in March, 1963, and the fourth and final in June, 1963.

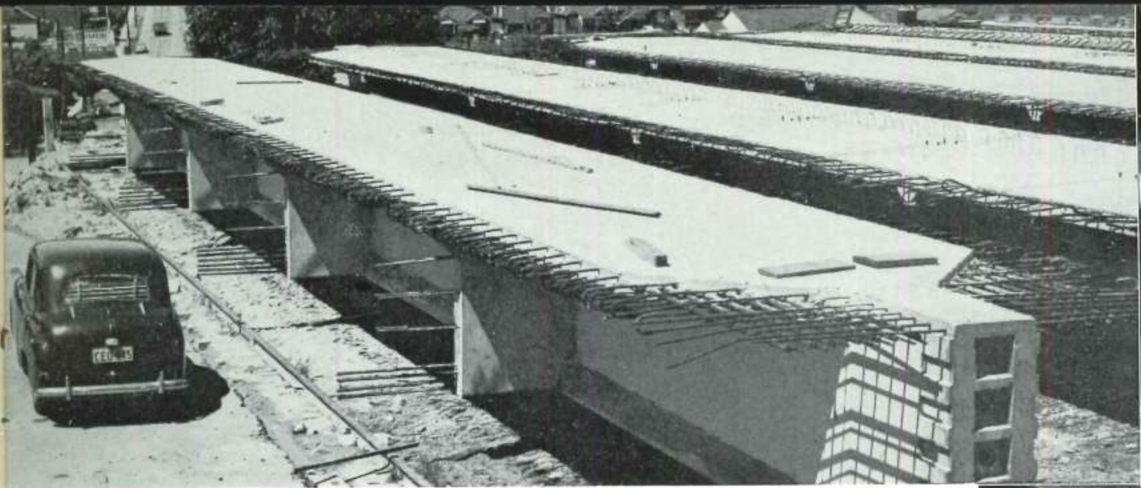
4



5



The four ribs of the arch have been completed and are self-supporting



DECK BEAMS

Prestressed concrete beams for the spans of the bridge deck were manufactured at casting yards at each end of the bridge. There are 143 deck beams in the bridge.

Top *Precast deck beams* Right *The underside of an approach span*

Bottom *A deck beam being launched into position*

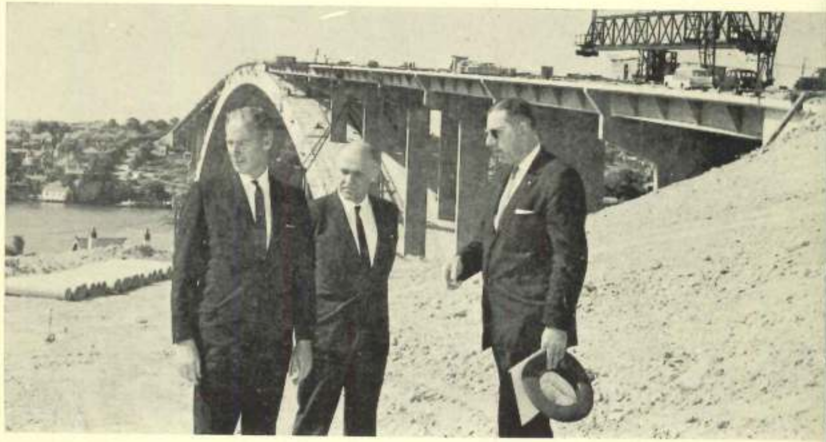
Each deck beam, 65 tons in weight, was lifted by a special launching truss and placed in position on its seating.

In February, 1964 the last deck beams were launched into position to form a continuous base for the six-lane-road over the longest concrete arch span in the world.

Top left *Placing of deck beams nearing completion*

Bottom left *Deck beams form a continuous support for the roadway*

Below *The Deputy Premier, the Hon. P. D. Hills, M.L.A.,* (left) *the Commissioner for Main Roads, Mr. J. A. L. Shaw,* (right) *and the Assistant Commissioner for Main Roads, Mr. R. J. S. Thomas at the bridge site following the launching of the last deck beam*



COMPLETION OF WORK

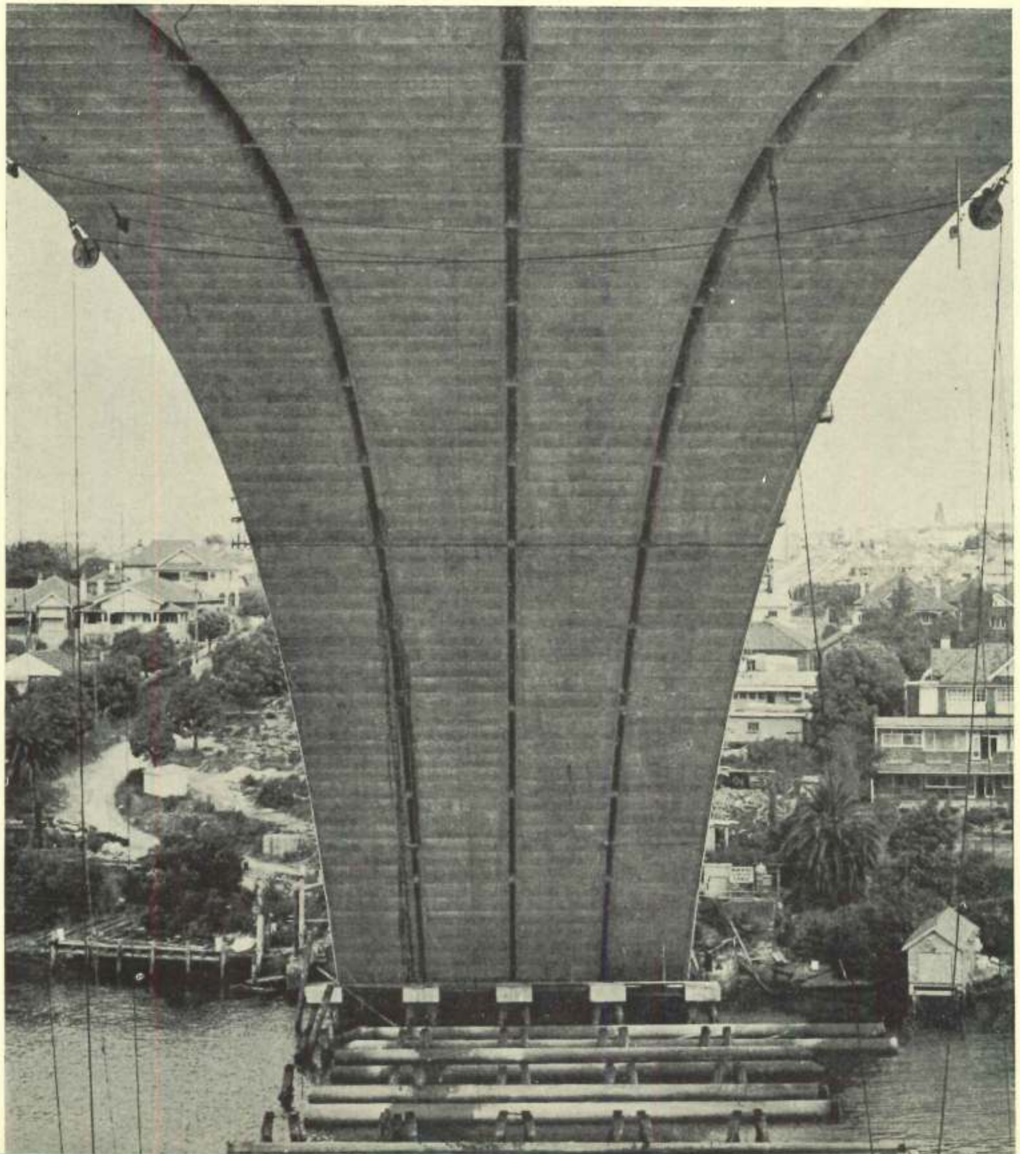
As the erection of pier columns and deck beams was completed, the concrete deck between the beams and the concrete footway cantilevers were cast in place.

The falsework was removed from under the arch.

Finally, the footways, handrailing and light standards were erected, and an asphaltic-concrete wearing course was laid on the roadway.

Top *Portion of the steel truss span of the falsework being removed*

Left *Removal of steel tubular columns which formed part of the falsework*



The underside of the four arch ribs after removal of the falsework

TESTING OF MATERIALS

Because of the importance of controlling the quality of materials, and in particular concrete, used in the bridge, special arrangements for testing were set up.

A concrete testing laboratory was established at the bridge site. Here, samples were stored in a "fog room" under conditions of constant temperature and humidity until tested.

Equipment installed in the laboratory included a 200-ton capacity testing machine, capping equipment, diamond saw, drying oven and mixing unit for investigation of the concrete materials and mixes used in the project.

In addition to continuous day-to-day testing of concrete aggregate, cement and concrete, the research staff of the Department of Main Roads carried out special long-term creep and shrinkage tests in the concrete used in the project so that appropriate allowances could be made when the ribs of the arch were placed in compression and freed from the falsework.

Testing of sandstone was also carried out at the laboratory at the bridge site.

Testing of steel reinforcement and high tensile steel bar and steel wire strand was undertaken at the Department's Central Testing Laboratory.

The testing laboratory of the Department of Main Roads at the bridge site

MAINTENANCE

The amount of maintenance required on the new bridge will be very small and will consist mainly of repainting of handrails and resurfacing of the roadway on the deck of the bridge.

So far as the life of the bridge is concerned, there is no limit, under normal conditions, to the number of years for which the structure should last.

APPROACHES

The Drummoyne (or southern) approach to the new bridge now connects with Victoria Road. Ultimately, this approach will connect with further lengths of the North-Western Expressway to be constructed from the City.

The next section of the North-Western Expressway to be constructed will be from Druitt Street, across Darling Harbour railway goods yard to Fig Street, and over Wentworth Park to Bridge Road, Glebe.

Preparation of the design for this section of the North-Western Expressway is in hand.

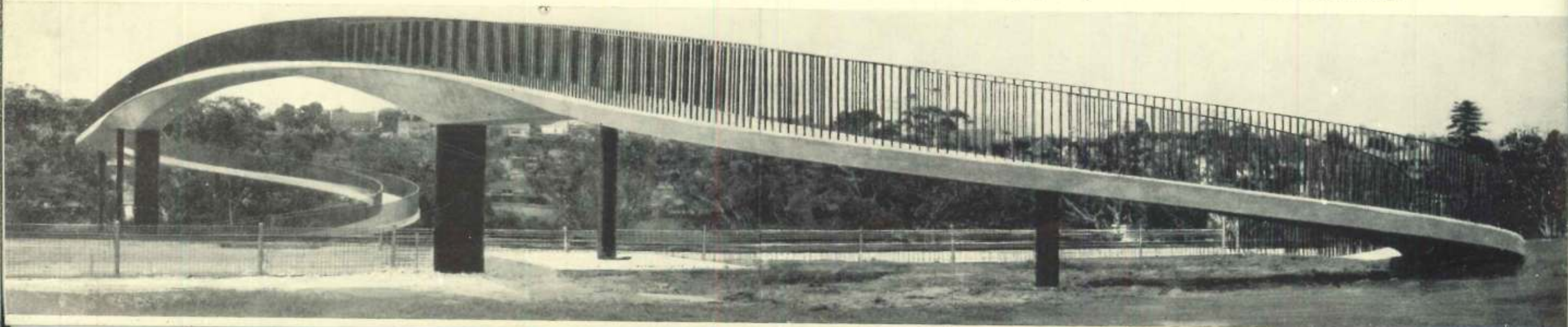
At the Gladesville (or northern) end of the new bridge, the North-Western Expressway will pass over Tarban Creek across which a bridge is now being built and connect with the recently completed Fig Tree Bridge.

Traffic travelling from the City to Gladesville, Ryde and other areas to the west will leave the bridge on a new road connecting with Victoria Road on the northern side of the river.

Traffic travelling towards the City from Gladesville, Ryde and other areas to the west will gain access to the new bridge via an overpass, the Huntley's Point Overpass, beneath which the main route of the North-Western Expressway will pass before crossing Tarban Creek. The Huntley's Point Overpass also spans the link road being provided to enable traffic from these areas to join the expressway for north-bound travel.

Spanning the Victoria Road connection to the bridge on the northern side of the river, an overbridge has been provided for pedestrians.

The pedestrian overbridge spanning the Victoria Road connection to the bridge



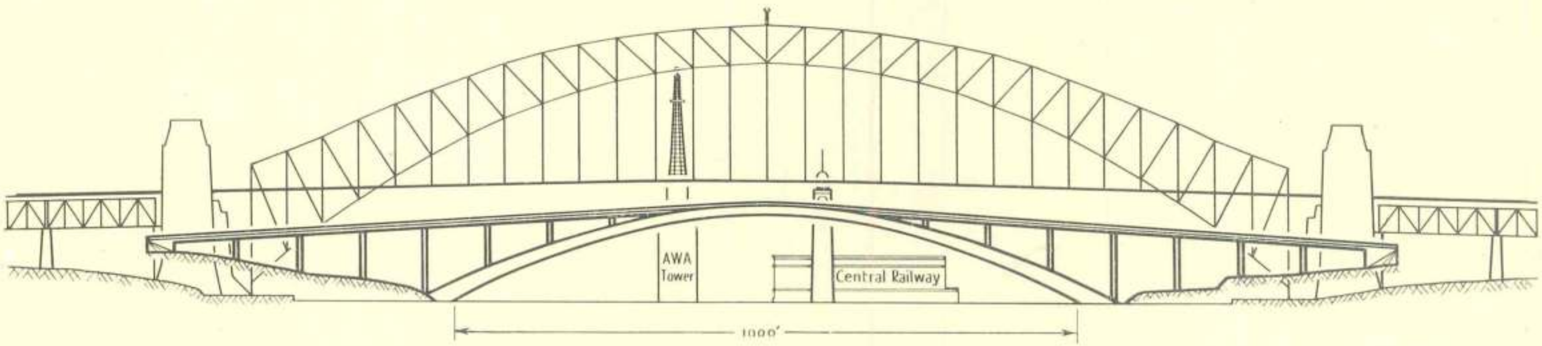
COST OF WORKS

The cost of the new bridge and the cost of the road and bridge works comprising the approaches will be of the order of £4.5m.

This brochure was prepared by the Dept. of Main Roads New South Wales

Commissioner for Main Roads
J. A. L. Shaw, D.S.O., B.E., M.I.E.Aust.

Assistant Commissioner for Main Roads
R. J. S. Thomas, A.S.T.C., M.I.E.Aust.



The new bridge compared with Sydney Harbour Bridge, Sydney Central Railway Station Tower and Amalgamated Wireless (Australasia) Tower

SYDNEY ROAD BRIDGES

OVER 200 FEET IN LENGTH

EXISTING

	Type	*Length in feet*
Sydney Harbour Bridge	Steel	3,770
Middle Harbour at The Spit	Steel & Concrete	745
Middle Harbour at Roseville (a new bridge is being constructed)	Concrete	240
Long Bay at Northbridge	Concrete	500
Pyrmont	Steel & Timber	1,215
Iron Cove	Steel & Concrete	1,536
Glebe Island Bridge at Johnston's Bay	Steel	355
Parramatta River between Gladesville and Drummoyne (old)	Iron	896
Parramatta River between Gladesville and Drummoyne (new)	Concrete	1,901
Parramatta River at Uhr's Point—Ryde Bridge	Steel & Concrete	1,135
Parramatta River at Silverwater	Concrete	615
Parramatta River—Gasworks Bridge	Steel & Masonry	362
Parramatta River at O'Connell Street	Concrete	290
Lane Cove River—Fig Tree Bridge	Steel & Concrete	749
Lane Cove River—Epping Road	Concrete	242
Lane Cove River—De Burgh's Bridge	Steel & Timber	298
George's River at Tom Ugly's Point	Steel & Concrete	1,638
Salt Pan Creek	Concrete	602
Cook's River—General Holmes Drive	Concrete	566
Cook's River at Tempe	Concrete	300
Shea's Creek at Alexandria	Concrete	246
George's River at Milperra (a new bridge is being constructed)	Timber	240
George's River at Liverpool	Steel & Concrete	912
Prospect Creek at Lansdowne	Concrete	222

UNDER CONSTRUCTION

Tarban Creek	Concrete	747
George's River at Taren Point	Concrete	1,662
Hawthorne Canal	Concrete	359
Parramatta River at Aston Street, Camellia	Concrete	448
Middle Harbour at Roseville	Concrete	1,230
George's River at Milperra	Concrete	284

PRINTED BY VICTOR CHARLES N. BLIGHT, GOVERNMENT PRINTER, SYDNEY, NEW SOUTH WALES

CONTRACTORS

Stuart Brothers, builders, of Sydney
and
Reed and Mallik, engineering contractors, of Salisbury, England

DESIGN ENGINEERS

Messrs. G. Maunsell and Partners, consulting engineers, of London and Melbourne

DEPARTMENT'S CONSULTANTS

Civil Engineering Department, University of Sydney

Société Technique pour l'Utilisation de la Précontrainte, of Paris

Fowell, Mansfield and Maclurcan, architects, of Sydney

MAJOR SUB-CONTRACTORS

Ready Mixed Concrete (N.S.W.) Pty. Ltd.
Establishment of concrete mixing plants and supply of concrete

E.P.M. Concrete (N.S.W.) Pty. Ltd.
Manufacture of arch jacking blocks, beam end blocks and diaphragms

Sydney Steel Company Pty. Ltd.
Supply and manufacture of steel falsework

Continued alongside

R. S. Morris & Company Ltd.
Placing concrete reinforcement

V. H. Moy Constructions Pty. Ltd.
Manufacture of lamp posts

J. W. Broomhead & Sons Pty. Ltd.
Manufacture of steel bearings and inner footway protective barrier

Lift Slab of Australia Ltd.
Transverse movement of arch falsework

Matthias Engineering Company
Manufacture of outer footway protective barrier

Machine Enterprises Pty. Ltd.
Excavation for foundations

Hawaiian Australian Concrete Pty. Ltd.
Manufacture of footway slabs

Prestressed Concrete (Aust.) Pty. Ltd.
Jacking of arch ribs

Humes Ltd.
Manufacture of falsework piles and columns

Sydney Bridge and Wharf Pty. Ltd.
Driving and extracting falsework piles

Cockatoo Docks & Engineering Co. Pty. Ltd.
Erection of steel falsework and precast concrete columns and headstocks

CONTRACTORS FOR SUBSIDIARY WORKS

Hutcherson Brothers Pty. Ltd.
Construction of Huntley's Point Overpass

Pearson Bridge Pty. Ltd.
Construction of footbridge